



Video

FULL DETAILS AND TRANSCRIPT

## Teaching Fractions

Hung-Hsi Wu, Ph.D. • October 2008

Topic: National Math Panel: Critical Foundations for Algebra  
Practice: Mathematics Preparation for Algebra

### Highlights

- Use of symbols as foundational for learning algebra
- Teach children gradually to learn to use symbols
- Fractions as abstract concept
- Presenting operations with fractions using symbols

### About the Interviewee

Hung-Hsi Wu is a differential geometer by profession. He has authored research papers and research monographs, as well as three graduate level textbooks in mathematics in Chinese. In 1992, he was moved by what he witnessed in the mathematics education reform and was determined to initiate change in mathematics education. After 1996, he started to participate in the education process full-time, first as a critic and then as a member of various state and national committees. He probably played a role in changing the practices of professional development in California as well as the attitude of textbook publishers toward textbook writing. His latest project is the improvement of the

professional development of teachers, both pre-service and in-service. He has been engaged in in-service work since 2000, and starting with 2006, he has begun working on the pre-service professional development of high school teachers. Wu has written extensively on mathematics education, and his articles can be accessed from his homepage: <http://math.berkeley.edu/~wu>.

## Full Transcript

I am Hung-Hsi Wu. I am professor of Mathematics at the University of California at Berkeley, and I was on the National Mathematics Panel. On that panel, I was in two task groups, one is the task group on conceptual understanding and skills, and the other one is on teachers. Now, the former, on conceptual understanding and skills, has to do with explaining what algebra is, and also more or less the content aspect of what students need to know in order to achieve algebra.

Fluency and use of symbols is truly foundational and truly basic in the learning of algebra. We have not done our job in teaching our kids gradually to learn to use symbols, so that their mind is freed of very specific numbers, but to think overall. So, if you want to learn algebra, and you are stuck on this mode of one number, two numbers, three numbers, you'll never learn it, but this is not something we are emphasizing enough right now in the whole K-12 curriculum.

Well basically, roughly it's like this, I am exaggerating a little bit, but it's like this, K-7 kids are supposed to be learning elementary things. We are not supposed to give them a hard time. We coddle them, make things as simple as possible. We dumb it down, especially in the learning of fractions. Fraction is actually already an abstract object that demands the concept of generality, but we don't, the way you teach fractions is, never mind the abstraction, what is a fraction? Piece of pizza, draw a picture, that's it. Now that's very bad, because this is the gateway to algebra, because you begin to learn about abstract objects, no longer one specific number, but a collection of it.

To define a fraction correctly, you have to think about, for example, think about all fractions whose denominator is three, you'll have to have that concept, you begin to think about that. And you want to add two fractions—I hope this is understandable by verbal description—you want to add two fractions, one fraction is  $A/B$ , the other is  $C/D$  then you say, given these two fractions, you add them what you get, what you get is  $AD+BC/BD$ , that's use of symbols. To express, no matter what the fraction may be, and that doesn't have to be  $2/3$ , doesn't have to be  $1/4$ , it could be all of those, but express it by  $A/B$ , where  $A$  is any whole number,  $B$  is any non-zero whole number and same is for  $C/D$ . Now you teach kids that way, they begin to get the idea that they don't have to be stuck with one number, two numbers, or three numbers, but they can begin to think about all the whole numbers, and you will add two fractions where  $A$ ,  $B$ ,  $C$ ,  $D$  could be any whole number. You'll add them just to get an expression, which is  $AD+BC/BD$ , you start to teach that way. And now, by the way, in the process you notice that, we have used symbols  $A$ ,  $B$ ,  $C$ ,  $D$  as whole

numbers. When you do it properly like that, kids, when they come to algebra, they say, “Oh that’s a piece of cake. I have seen it before, nothing new.” They then concentrate on the real difficulties. That’s what makes learning possible.

Right now, we don’t teach them to use symbols, so when they come to eighth grade, you teach algebra, they have this shock of seeing so many symbols and in addition to the symbols, of course, the new concepts they have to learn. Well, this is you are asking them to learn three or four new things at the same time. Very few of us can do that, I probably cannot do it. One thing at a time is alright, but two or three, no, probably not. And this is why right at the beginning, let’s get it out of the way, get them used to use of symbols. And, of course, in the National Math Panel report, we actually described what you can do to get kids used to the use of symbols. So we get that out of the way, then you can talk about linear equation, quadratic equation, periodic functions, whatever it is. You are then in a position to get to the next level.